# A note on plausible rates of population growth in humpback whales

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ABSTRACT

The literature on vital rates of humpback whales is reviewed to provide ranges of values for survival, pregnancy rate and age at first parturition; these data are then used to calculate plausible minimum and maximum rates of population growth. The *minimum* scenario (survival 0.95 with first-year survival 0.92, pregnancy rate 0.37, age at first parturition 9 years) gives a population growth rate of <0.039. The *maximum* scenario (survival of all classes 0.99, pregnancy rate 0.50, age at first parturition 5 years) yields a growth rate of 0.126. Consequently, we suggest that any calculated rate of population growth greater than 12.6% is unlikely to be biologically realistic for this species.

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## Introduction

Recent discussion within the IWC Scientific Committee has highlighted the need for setting realistic bounds on rates of population growth for humpback whales in the Southern Hemisphere. Last year, Brandão *et al.* (2000) calculated maximum growth rates for humpback whale populations assuming different values for survival rate, annual pregnancy rate and age at first parturition. Here we review pertinent literature on these values and use the results to suggest a plausible range of growth rates. We assume an even sex ratio in all populations, an assumption which is clearly reasonable given extensive data from both whaling catches and longitudinal studies (e.g. Chittleborough 1965, Clapham *et al.* 1995).

Summaries of selected vital rates derived from studies of humpback whales are given by area in Friday (2000) as an appendix to the report of an intersessional working group on rates of increase in Northern and Southern Hemisphere humpback whales.

## Parameter values

*Survival*

We are aware of only two recent studies of humpback whales which have attempted to estimate survival. Buckland (1990) estimated annual survival in the Gulf of Maine population from photo-identification data at 0.951 (SE = 0.01). The interbirth interval model of Barlow and Clapham (1997) used a more complete and updated data set from the same region to estimate non-calf survival at 0.960 (SE = 0.0083), and calf survival at 0.875 (SE = 0.047). In their calculations of maximum possible population growth rates, Brandão *et al.* (2000) made provision (their Table 2) for a first-year survival rate that was 0.03 lower than the non-calf survival rate. For the purpose of this paper, we adopt this approach in combination with a range of non-calf survival rates of 0.95 to 0.99.

*Annual pregnancy rate*

Estimates of true pregnancy rate are impossible to derive from studies of free-ranging whales, and biases in catch data also

make estimation of this parameter difficult. Apparent pregnancy rates calculated from observations of calves in longitudinal photo-identification studies certainly underestimate true rates because of unrecorded prenatal or neonatal mortality. That said, observed calving rates as well as pregnancy rates derived from whaling catches can together set a reasonably precise range of plausible values for this parameter. Various long-term studies have estimated calving rate, usually measured as ?calves per mature female per year?. Of these, the lowest mean value is 0.37 for southeastern Alaska (Baker *et al.* 1987), while the highest values are 0.50 for Sitka Sound, Alaska (Straley 1994) and 0.58 for Hawaii (Baker *et al.* 1987). The latter figure is likely to be an overestimate because of sampling bias (see discussion in Clapham and Mayo 1990). Clapham and Mayo (1990) give a mean value of 0.41 for the Gulf of Maine. Pregnancy rates derived from whaling catch data are within these bounds. Consequently, a reasonable range for pregnancy rate is 0.37 to 0.50.

*Age at first parturition*

This can be derived from longitudinal studies of individually identified humpback whales of known age (i.e. those first observed as calves). It can also be calculated from whaling catch data by taking the mean age at attainment of sexual maturity (ASM) and adding a year for gestation (assuming that females reproduce immediately upon attaining ASM). In the long-term study of humpback whales in the Gulf of Maine, the mean age at first parturition was reported as 6 years; some individuals gave birth for the first time at 5 years old but none at ages younger than this (Clapham 1992, Barlow and Clapham 1997). The mean of 6 years is consistent with Chittleborough?s (1965) estimate of 5 years for mean ASM among female humpback whales caught in Areas IV and V. Straley (pers. comm.) indicates from her long-term study of humpback whales in Sitka Sound, Alaska, that age at first parturition there is 8-9 years; if this is not due to sampling bias, it indicates the existence of inter-population differences in this parameter. Thus, a reasonable range of values for age at first parturition is 5 to 9 years.

**Plausible rates of population growth**

Combinations of the parameter ranges defined above would give the following scenarios:

(i) *Minimum:* survival 0.95 (with first-year survival 0.92), pregnancy rate 0.37, age at first parturition 9 years.

(ii) *Maximum:* survival (all classes) 0.99, pregnancy rate 0.50, age at first parturition 5 years.

Applying these values to Tables 1 and 2 of Brandão *et al.* (2000), the maximum rates of population growth that appear plausible for humpback whales range from <0.039[1] (minimum) to 0.126 (maximum). Consequently, we suggest that any calculated rate of population growth greater than 12.6% is unlikely to be biologically realistic for this species.

[1]Table 2 of Brandão *et al.* (2000) does not provide an option for a pregnancy rate of 0.37 but instead uses a default of 0.40.

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